CLAIMS

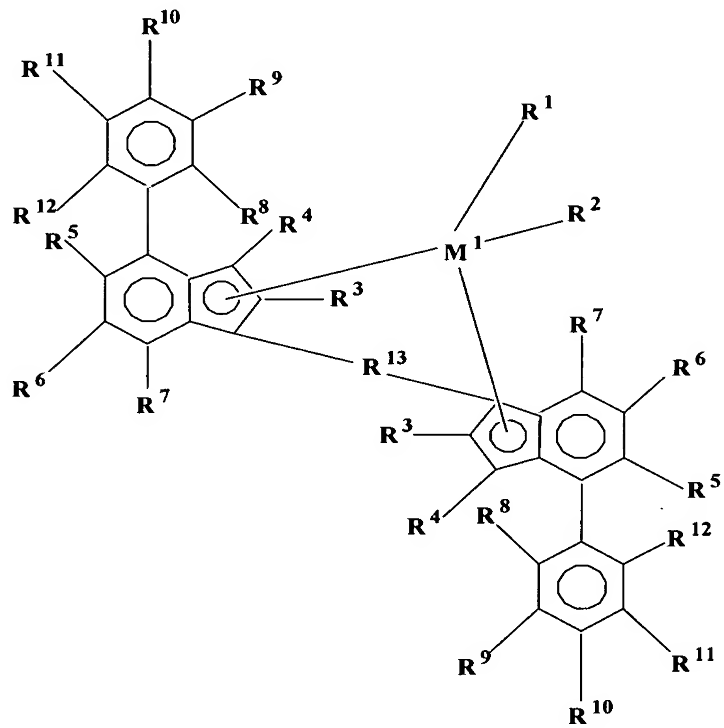
WHAT IS CLAIMED IS:

1. A process of preparing a polymer composition that comprises branched crystalline polypropylene, said process comprising: contacting a metallocene catalyst compound with a polymerization medium that comprises propylene monomers; and conducting polymerization of the propylene monomers at a temperature greater than 70°C for a time sufficient to provide branched crystalline polypropylene that has from 0.0 wt% to 2.0 wt% ethylene and a heat of fusion of 70 J/g or more.

2. A process of preparing a polymer composition that comprises branched crystalline polypropylene, said process comprising:
combining a metallocene catalyst compound with propylene monomers in a polymerization medium having less than 30 volume percent diluent;
conducting polymerization of the propylene monomers in the polymerization medium at a reaction temperature of over 70°C to form branched crystalline polypropylene; and
recovering branched crystalline polypropylene that has from 0.0 wt% to 2.0 wt% ethylene and a heat of fusion of 70 J/g or more.

3. A process of preparing a branched crystalline polypropylene composition, comprising:
contacting a polymerization mixture that comprises propylene monomers with a bridged metallocene compound that has at least two indenyl rings or derivatives of indenyl rings, each ring being substituted at the 2 and 4 positions; and
conducting polymerization of the propylene monomers for a time sufficient to form branched crystalline polypropylene composition having a heat of fusion of 70 J/g or more.

4. A process of preparing a branched crystalline polypropylene composition, comprising: combining a catalyst system that comprises a metallocene compound with a polymerization mixture that comprises propylene monomers in a reactor system, and carrying out polymerization of the propylene monomers in the reactor system for a time sufficient to form branched crystalline polypropylene, in which: the metallocene compound is represented by the formula:



(I)

wherein:

M^1 is selected from the group consisting of titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum and tungsten;

R^1 and R^2 are identical or different, and are one of a hydrogen atom, a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a C_6-C_{10} aryl group, a C_6-C_{10} aryloxy group, a C_2-C_{10} alkenyl group, a C_2-C_{40} alkenyl group, a C_7-C_{40} arylalkyl group, a C_7-C_{40} alkylaryl group, a C_8-C_{40} arylalkenyl group, an OH group or a

halogen atom; R^1 and R^2 may also be joined together to form an alkanediyl group or a conjugated C_{4-40} diene ligand which is coordinated to M^1 in a metallocyclopentene fashion; R^1 and R^2 may also be identical or different conjugated dienes, optionally substituted with one or more hydrocarbyl, tri(hydrocarbyl)silyl groups or hydrocarbyl, tri(hydrocarbyl)silylhydrocarbyl groups, said dienes having up to 30 atoms not counting hydrogen and forming a π complex with M, examples include 1,4-diphenyl-1,3-butadiene, 1,3-pentadiene, 2-methyl-1,3-pentadiene, 2,4-hexadiene, 1-phenyl-1,3-pentadiene, 1,4-dibenzyl-1,3-butadiene, 1,4-ditolyl-1,3-butadiene, 1,4-bis(trimethylsilyl)-1,3-butadiene, and 1,4-dinaphthyl-1,3-butadiene;

Each R^3 is identical or different from the other R^3 and is each a hydrogen atom, a halogen atom, a C_1-C_{10} alkyl group which may be halogenated, a C_6-C_{10} aryl group which may be halogenated, a C_2-C_{10} alkenyl group, a C_7-C_{40} -arylalkyl group, a C_7-C_{40} alkylaryl group, a C_8-C_{40} arylalkenyl group, a $-NR'_2$, -SR', -OR', $-OSiR'_3$ or $-PR'_2$ radical, wherein R' is one of a halogen atom, a C_1-C_{10} alkyl group, or a C_6-C_{10} aryl group;

R^4 to R^7 are identical or different and are hydrogen, or are as defined for R^3 or two or more adjacent radicals R^5 to R^7 together with the atoms connecting them form one or more rings;

R^{13} is

$$\begin{array}{c}R^{14}\\ |\\ -M^2-\\ |\\ R^{15}\end{array}, \quad \begin{array}{c}R^{14}\quad R^{14}\\ |\qquad |\\ -M^2-M^2-\\ |\qquad |\\ R^{15}\quad R^{15}\end{array}, \quad \begin{array}{c}R^{14}\\ |\\ -M^2-(CR_2^{16})-\\ |\\ R^{15}\end{array},$$

$$\begin{array}{c}R^{14}\\ |\\ -O-M^2-O-\\ |\\ R^{15}\end{array}, \quad \begin{array}{c}R^{14}\\ |\\ -C-\\ |\\ R^{15}\end{array}, \quad \begin{array}{c}R^{14}\\ |\\ -O-M^2-\\ |\\ R^{15}\end{array}$$

$-B(R^{14})-$, $-Al(R^{14})-$, -Ge-, -Sn-, -O-, -S-, -SO-, $-SO_2-$, $-N(R^{14})-$, -CO-, $-P(R^{14})-$, or $-P(O)(R^{14})-$;

wherein: R^{14}, R^{15} and R^{16} are identical or different and are a hydrogen atom, a halogen atom, a C_1-C_{20} branched or linear alkyl group, a C_1-C_{20} fluoroalkyl or silaalkyl group, a C_6-C_{30} aryl group, a C_6-C_{30} fluoroaryl group, a C_1-C_{20} alkoxy group, a C_2-C_{20} alkenyl group, a C_7-C_{40} arylalkyl group, a C_8-C_{40} arylalkenyl group, a C_7-C_{40} alkylaryl group, or R^{14} and R^{15}, together with the atoms binding them, form a cyclic ring;

or, R^{13} is represented by the formula:

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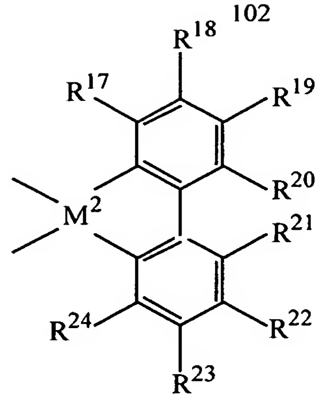

wherein: R^{17} to R^{24} are as defined for R^1 and R^2, or two or more adjacent radicals R^{17} to R^{24}, including R^{20} and R^{21}, together with the atoms connecting them form one or more rings;

M^2 is one or more carbons, silicon, germanium or tin; and

R^8, R^9, R^{10}, R^{11} and R^{12} are identical or different and have the meanings stated for R^4 to R^7.

5. The process of claim 1 in which the polymerization medium has a first phase that comprises propylene monomers and a second phase that comprises the branched crystalline polypropylene.

6. The process of claim 1 in which the polymerization medium has a first phase that comprises propylene monomers and a second phase that comprises the branched crystalline polypropylene, wherein the first phase has less than 30 volume percent diluent.

7. The process of claim 1 in which the polymerization medium has a first phase that comprises propylene monomers and a second phase that comprises the branched crystalline polypropylene, wherein the second phase is a solid phase.

8. The process of claim 1 in which the polymerization medium has a first phase that comprises propylene monomers and macromers and a second phase that comprises the branched crystalline polypropylene.

9. The process of claim 1, in which the polymerization of the propylene monomers is conducted at a temperature of 75 °C or higher.

10. The process of claim 1, in which the polymerization of the propylene monomers is conducted at a temperature of 80 °C or higher.

11. The process of claim 1, in which the polymerization of the propylene monomers is conducted at a temperature of 90 °C or higher.

12. The process of claim 1, in which the branched crystalline polypropylene has a crystallization temperature (Tc) of 100 °C or more.

13. The process of claim 1, in which the branched crystalline polypropylene has a crystallization temperature (Tc) or 105 °C or more.

14. process of claim 1, in which the branched crystalline polypropylene has a crystallization temperature (Tc) of 110 °C or more.

15. The process of claim 1, in which the branched crystalline polypropylene has a crystallization temperature (Tc) of from 105 °C to 110 °C.

16. The process of claim 1, in which the branched crystalline polypropylene has a melting point (Tm) of 145 °C or more.

17. The process of claim 1, in which the branched crystalline polypropylene has a melting point (Tm) of 150 °C or more.

18. The process of claim 1, in which the branched crystalline polypropylene has a melting point (Tm) of 155 °C or more.

19. The process of claim 1, in which the branched crystalline polypropylene has a melting point (Tm) of 160 °C or more.

20. The process of claim 1, in which the branched crystalline polypropylene has a melting point (Tm) of from 145 °C to 160 °C.

21. The process of claim 1, in which the branched crystalline polypropylene has a Melt Flow Rate of 0.5 or more.

22. The process of claim 1, in which the branched crystalline polypropylene has a Melt Flow Rate of 0.7 or more.

23. The process of claim 1, in which the branched crystalline polypropylene has a Melt Flow Rate of 1.0 or more.

24. The process of claim 1, in which the branched crystalline polypropylene has a Melt Flow Rate of 1.5 or more.

25. The process of claim 1, in which the supported metallocene comprises dimethylsilylbis(2-methyl-4-phenyl-1-indenyl)zirconium dimethyl.

26. The process of claim 1, in which the supported metallocene comprises dimethylsilylbis(2-methyl-4-phenyl-1-indenyl)zirconium dimethyl or dimethylsilylbis(2-methyl-4-phenyl-1-indenyl)zirconium dichloride.

27. The process of claim 1, in which the supported metallocene comprises dimethylesilylbix(2-methyl-4-naphthyl-1-indenyl)zirconium dimethyl or dimethylesilylbix(2-methyl-4-naphthyl-1-indenyl)zirconium dichloride.

28. The process of claim 1, in which the supported metallocene comprises a dimethylanilinium tetrakis (perfluorophyl) boron activator.

29. The process of claim 1, in which the supported metallocene comprises a methylalunimoxane activator.

30. The process of claim 2, in which polymerization medium has less then 25 volume percent diluent.

31. The process of claim 2, in which polymerization medium has less then 20 volume percent diluent.

32. The process of claim 2, in which polymerization medium has less then 10 volume percent diluent.

33. The process of claim 1, in which the branched crystalline polypropylene has a propylene content of 97 wt% or more.

34. The process of claim 1, in which the branched crystalline polypropylene has from 0.0 wt% to 0.01 wt% alpha omega dienes.

35. The process of claim 1, in which the branched crystalline polypropylene is isotactic or syndiotactic.

36. The process of claim 1, in which the metallocene catalyst compound is combined with propylene in the absence of hydrogen or in the presence of hydrogen in an amount of up to 1.0 mole% hydrogen in the reactor.

37. The process of claim 1, in which the heat of fusion of the branched crystalline polypropylene is 80 J/g or more.

38. The process of claim 1, in which the Heat of fusion of the branched crystalline polypropylene is 90 J/g or more.

39. The process of claim 1, in which the heat of fusion of the branched crystalline polypropylene is 100 J/g or more.

40. The process of claim 1, in which the branched crystalline polypropylene has a Branching Index of 0.97 or less.

41. The process of claim 1, in which the branched crystalline polypropylene has a Branching Index of 0.95 or less.

42. The process of claim 1, in which the branched crystalline polypropylene has a Branching Index of 0.90 or less.

43. The process of claim 1, in which the branched crystalline polypropylene has a Branching Index of 0.80 or less.

44. The process of claim 1, in which one of the metallocene catalyst compounds comprises a substituted or unsubstituted silyl bridged bis-indenyl metallocene.

45. The process of claim 1, in which the polymerization medium comprises more than 70% propylene monomers by volume prior to the beginning of polymerization.

46. The process of claim 1, in which the polymerization medium consists essentially of propylene monomers.

47. The process of claim 1, in which the polymerization medium consists essentially of monomers and a substantially inert solvent or diluent.

48. The process of claim 1, in which the branched polypropylene is a homopolymer.